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Two new block designs

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Abstract

In this note the matrices W, X. Y, and Z are the incidence matrices of the (u, k, ,\,) configurations (15, 7, 3), (25,9,3), (45, 12,3), and (36, 15,6), respectively. Wand X are new formulations of these configurations and Yand Z were previously not known (see [I, pp. 295, 297]).

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NOTE

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In this note the matrices W, X, Y, and Z are the incidence matrices of the (v, k, λ) configurations (15, 7, 3), (25, 9, 3), (45, 12, 3), and (36, 15, 6), respectively. W and X are new formulations of these configurations and Y and Z were previously not known (see [1, pp. 295, 297]).

We use the following notation:

$$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \quad L = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix}, \quad M = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, \quad J = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix},$$

$$e = [1, 1, 1] \qquad \text{and} \qquad \epsilon = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix};$$

all blank blocks contain all zeros.

The incidence matrices are

$$W = \begin{bmatrix} J & I & I & I & I \\ I & J & I & L & M \\ I & I & J & M & L \\ I & L & M & J & I \\ I & M & L & I & J \end{bmatrix},$$

$$X = \begin{bmatrix}
 & & & & & & & e & e & e & & & \\
 & & e & & & & & e & & & & & e \\
 & & e & & & & & & e & & e & & \\
 & & e & & & & & & & e & & e & \\
 & & & & & & & I & I & I & J-I & J-I & J-I \\
\epsilon & \epsilon & & & \epsilon & & & I & I & I & I & I & I \\
\epsilon & & \epsilon & & & \epsilon & & I & M & L & I & M & L \\
\epsilon & & & \epsilon & & & \epsilon & I & L & M & I & L & M \\
 & & I & & & J-I & & I & & J-I & J-I & & I \\
 & & I & & & J-I & & J-I & I & & I & J-I & \\
 & & I & & & J-I & & & J-I & I & & I & J-I
\end{bmatrix},$$

$$
Y = \left[\begin{array}{ccc|ccc|ccc|ccc|ccc}
J & & & & & & I & I & I & I & I & I & I & I & I \\
 & J & & & & & L & L & L & M & M & M & I & I & I \\
 & & J & & & & M & M & M & L & L & L & I & I & I \\
\hline
 & & & J & & & I & L & M & I & M & L & I & L & M \\
 & & & & J & & L & M & I & M & L & I & I & L & M \\
 & & & & & J & M & I & L & L & I & M & I & L & M \\
\hline
I & L & M & I & M & L & J & & & & & & I & M & L \\
L & M & I & M & L & I & & J & & & & & I & M & L \\
M & I & L & L & I & M & & & J & & & & I & M & L \\
\hline
I & M & L & I & L & M & I & M & L & J & & & & & \\
M & L & I & L & M & I & I & M & L & & J & & & & \\
L & I & M & M & I & L & I & M & L & & & J & & & \\
\hline
I & I & I & I & I & I & & & & I & M & L & J & & \\
M & M & M & L & L & L & & & & I & M & L & & J & \\
L & L & L & M & M & M & & & & I & M & L & & & J
\end{array}\right],
$$

$$
Z = \left[\begin{array}{ccc|ccc|ccc|ccc}
 & J & J & I & I & I & I & I & I & I & I & I \\
J & & J & L & L & L & M & M & M & I & I & I \\
J & J & & M & M & M & L & L & L & I & I & I \\
\hline
I & M & L & & J & J & I & L & M & I & M & L \\
I & M & L & J & & J & L & M & I & M & L & I \\
I & M & L & J & J & & M & I & L & L & I & M \\
\hline
I & L & M & I & M & L & & J & J & I & L & M \\
I & L & M & M & L & I & J & & J & L & M & I \\
I & L & M & L & I & M & J & J & & M & I & L \\
\hline
I & I & I & I & L & M & I & M & L & & J & J \\
I & I & I & L & M & I & M & L & I & J & & J \\
I & I & I & M & I & L & L & I & M & J & J &
\end{array}\right].
$$

Reference

1. M. Hall, Jr., *Combinatorial Theory*, Blaisdell, Waltham, Mass., 1967.

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